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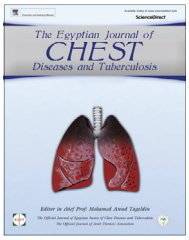

ORIGINAL ARTICLE

Management of airway foreign body using flexible bronchoscopy: Experience with 80 cases during 2011–2013

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KEYWORDS

Flexible bronchoscopy;
Foreign body;
Tracheo-bronchial tree

Abstract *Background:* Foreign body aspiration (FBA) into the tracheobronchial tree is a serious problem necessitating prompt recognition and management. This study aimed to report our experience in airway foreign body removal by flexible bronchoscopy.

Study design: Descriptive study.

Methods: A total of 80 patients with FBA were included in the study. They were 61 pediatric cases and 19 adult cases. Sixty-four were females and 16 cases were males, their age ranged from 2 to 52 years. The clinical manifestations, radiological findings and bronchoscopic findings of the procedure were analyzed.

Results: Among the patients, only 88.8% had a definite history of FBA. The most frequent symptom was paroxysmal cough (61.3%), followed by expectoration, fever or wheezing, hemoptysis and dyspnea. Chest X-ray showed radiopaque foreign body in 78.8% of the patients, normal chest radiology in 8.8% and right lower lobe consolidation in 6.3%. The most common location of FB was either right or left lower lobe bronchus (16, 20%). Sixty-two (77.5%) of FB inhalation were pins, followed by seeds in 6 patients (7.5%), and plastic toys in 5 patients (6.3%). The gestures that lead to FBA by the patients were during laughter in 28 cases (35%), chalking (26.2%), talking (15%) and sneezing (8.8%). In 9 patients (11.2%) the acts that lead to FBA were not identified by the patients.

Conclusions: Flexible bronchoscopy is successful in retrieving airway foreign bodies (88.8%). With skilled personnel and perfect equipments, flexible bronchoscopy could be considered as the first choice for the removal of airway foreign body.

Introduction

Aspiration of foreign body (FB) into the tracheobronchial tree is a common problem, especially in children, necessitating prompt recognition and early management. A delay of

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diagnosis and retention of FBs usually increase morbidity and mortality, ranging from chocking and fatal airway obstruction to recurrent chronic cough or wheezing and non specific chest infections [1–3]. Rigid bronchoscopy was considered as the main procedure for management of FB aspiration (FBA) [3–6].

Recently, flexible bronchoscopy has been widely used for the removal of foreign bodies. It allows doctors to get a detailed evaluation of the location and type of FB and airway changes with minimal complications [2,7–9].

In most cases diagnosis of FBA is made by positive history within few hours up to 2–3 days of the event. However, in some cases the diagnosis took from several weeks to months [10].

In the interventional bronchoscopy unit, Kasr El Aini hospital, Cairo University, we apply fibrobronchoscope in the initial evaluation and retrieval of FBs. With experience accumulated, we analyzed the clinical data of 80 cases with FBA and reviewed our experience with therapeutic flexible bronchoscopy for extraction of FBs.

Aims and objective

The objective of the study was to detect and analyze the rate of occurrence of foreign bodies inhaled in males and females in different age groups.

The study aimed to analyze the most common clinical manifestations, radiological findings and bronchoscopic finding of FBA and. also, to detect the number, the different types and gestures that lead to FB inhalation.

The study aimed to detect the success rate of using flexible bronchoscopy for the removal of airway foreign body.

Methods

This descriptive study was conducted prospectively and sampling done on conveniences by the approval of The Human Study Committee of Kasr El Aini Hospital of Cairo University. The study was carried out at the department of chest diseases, Kasr El Aini Hospital, Cairo University. A total of 80 patients with FBA undergoing flexible bronchoscopy from January 2011 to August 2013 were enrolled.

Depending on the age and body weight of the patients, 2 kinds of fibrobronchoscopes including Pentax EB-1170 K (external diameter: 2.8 mm, working channel: 1.2 mm) and Pentax EB-1830T3 (6 mm, 2.8 mm) were used. Other ancillary equipment included biopsy forceps, digital video work station, life monitors, oxygen supply system and emergency equipment.

Informed consents were obtained from the patients or patients' parents before the procedure. No food or drink was taken within 6 h before procedure. Flexible bronchoscopy was performed under sedation and local anesthesia. Atropine (0.01–0.02 mg/kg) was administered intramuscularly 20–30 min and midazolam (0.1–0.15 mg/kg) was injected 5–10 min before the procedure. Aerosolized lidocaine was sprayed on the throat first, and then lidocaine was dripped into the trachea and bronchus for local anesthesia during flexible bronchoscopy. Bronchoscope was inserted orally through a mouth piece. Biopsy forceps were used to remove the FB. Bronchoalveolar lavage (BAL) was performed for microbiological determinations in patients with a long duration of >15 days or presentation with inflammation during or after the FB was removed [11].

Heart rate, respiratory rate, and SpO_2 were monitored during the whole procedure, and if the patients were hypoxic (cyanosis, low SpO_2 and/or high heart rate), oxygen of appropriate concentration was given by nasal prong, and the procedure was ceased temporarily when necessary.

Statistical methods

Data were statistically described in terms of range, median, frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Chi square (χ^2) test. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

A total of 80 patients with FBA undergoing flexible bronchoscopy (61 pediatric cases and 19 adult cases) were enrolled in this study. They were 64 females and 16 males with age ranged from 2 years to 52 years with a median of 15 years. Female to male ratio was 4:1. The duration of FB retention ranged from 9 h to 12 years with a median of 2 weeks (Table 1).

Among the 80 patients, only 71 (88.8%) had a definite history of FBA and 8 patients (10%) had a history of unsuccessful trail of FB removal by rigid bronchoscopy. The most common symptom was paroxysmal cough (49, 61.3%), followed by expectoration (29, 36.3%), fever (25, 31.1%), wheezes (6, 7.5%), dyspnea and hemoptysis were each (3, 3.8%).

Table 1 Characteristics of patients with airway foreign bodies.

Characteristics	Numbers of patients	Percentage (%)
Gender		
Female	64	80
Male	16	20
Age		
Pediatric	61	76.3
2–10 years	23	37.7
11–18 years	38	62.3
Adult	19	23.7
19–28 years	13	68.4
29–38 years	3	15.8
39–48 years	2	10.5
More than 49 years	1	5.3
Median age (15 years)		
Range (2–52 years)		
Duration of FBA		
<1 day	1	1.25
1–15 days	68	85
16–30 days	2	2.5
1–6 months	5	6.25
6–12 months	2	2.5
1 year or more	2	2.5
Median duration(2 weeks)		
Range (9 h to 12 years)		

Table 2 Clinical manifestations, radiological findings and the most common location of FBs detected by CXR and/or flexible bronchoscopy in patients of FBA.

	Number of patients	Percentage (%)
History of FBA		
Yes	71	88.8
No	9	1
Symptoms		
Paroxysmal cough	49	61.3
Expectoration	29	36.6
Fever	25	31.1
Wheezes	6	7.5
Dyspnea	3	3.8
Hemoptysis	3	3.8
Radiological findings		
Radiopaque foreign body	63	78.8
Normal chest radiology	7	8.8
Right lower lobe consolidation	5	6.3
Right lower lobe consolidation collapse and pleural effusion	2	2.5
Left lower lobe consolidation	1	1.3
Obstructive emphysema of the left lung	1	1.3
Right lower lobe lung abscess	1	1.3
Location of FBs by flexible bronchoscopy		
Left lower lobe	16	20
Right lower lobe	16	20
Intermediate bronchus	14	17.5
Trachea	12	15
Left main bronchus	11	13.8
Right main bronchus	3	3.8
Lingula	2	2.5
Left main bronchus and left lower lobe	1	1.3
Left upper lobe	1	1.3
Lingula and left lower lobe	1	1.3
Right and left lower lobes	1	1.3
Right upper lobe	1	1.3
Supra Glottis	1	1.3

Normal chest radiology was found in 7 cases (8.8%). Chest X-ray showed radio-opaque foreign body in 63 patients (78.8%), right lower lobe consolidation in 5 cases (6.3%), right lower lobe consolidation collapse & pleural effusion in 2 cases (2.5%), a single case (1.3%) of left lower lobe consolidation, obstructive emphysema of the left lung and right lower lobe lung abscess each (Table 2).

The most common location of FB was either right or left lower lobe bronchus (16, 20%) each, followed by the intermediate bronchus (14, 17.5%), the trachea (12, 15%), left main bronchus (11, 13.8%), right main bronchus (3, 3.8%), lingual (2, 2.5%), 2 lobar bronchi in cases of more than one foreign body (3, 3.8%) and a single case (1.3%) of right upper lobe bronchus, left upper lobe bronchus and supra glottis each (Table 2).

Sixty-two (77.5%) of the FBs were pins, 35 (56.5%) of the pointed pin tip were lodged in their situation (Fig. 1), whereas in 27 cases (43.5%) the pointed tip was free. Vegetable or fruit seeds were found in 6 patients (7.5%), and plastic toys were noted in 5 patients (6.3%). Other FBs included metal particles (3, 3.8%) (Fig. 2), chicken bone (2, 2.5%) and a single (1.3%) case of fish fork and teeth each (Table 2). In 3 cases (3.8%) there was more than one FBA whereas in the rest of the cases (77, 96.2%) only a single FB was retrieved (Fig. 3).

The gestures that lead to FBA by the patients were during laughter in 28 cases (35%), choking (21, 26.2%), talking (12, 15%), sneezing (7, 8.8%), hiccough (2, 2.5%) and a single case (1.3%) while trial of endotracheal intubation. On the other hand, in 9 patients (11.2%) the act that led to FBA was not identified by the patients (Table 3).

Almost all the patients, 71 (88.8%) had FBs removed successfully by flexible bronchoscopy. Only, in 9 cases (11.2%), the FBs cannot be removed by the flexible bronchoscopy and they were turned to rigid bronchoscopy. They were 6 female patients and 3 male patients. In case of the female patients, the foreign bodies were pins with lodged tip in 5 cases and a big orange seed in a single case; while, in the other 3 male patients the foreign bodies were teeth, metal particle and a big water melon seed. In the case of the male patient with teeth inhalation, he had two teeth. One tooth was successfully removed by flexible bronchoscopy and for the other tooth; the patient was referred for removal by rigid bronchoscopy.

Discussion

Aspiration of foreign bodies in the trachea-bronchial tree is a common and life-threatening situation in children than in

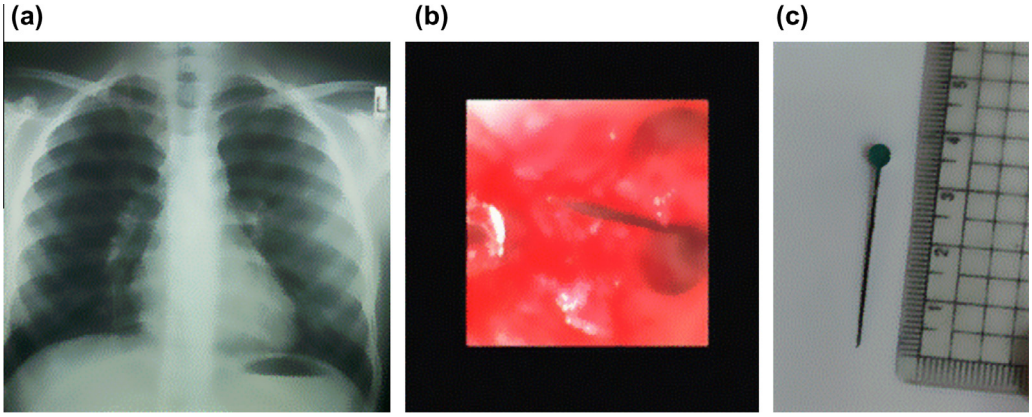

Fig. 1 (a) Chest X-ray shows a pin in the right lower lobe. (b) Bronchoscopic image shows the pin with its free tip upward. (c) Picture of the pin after removal by flexible bronchoscopy.

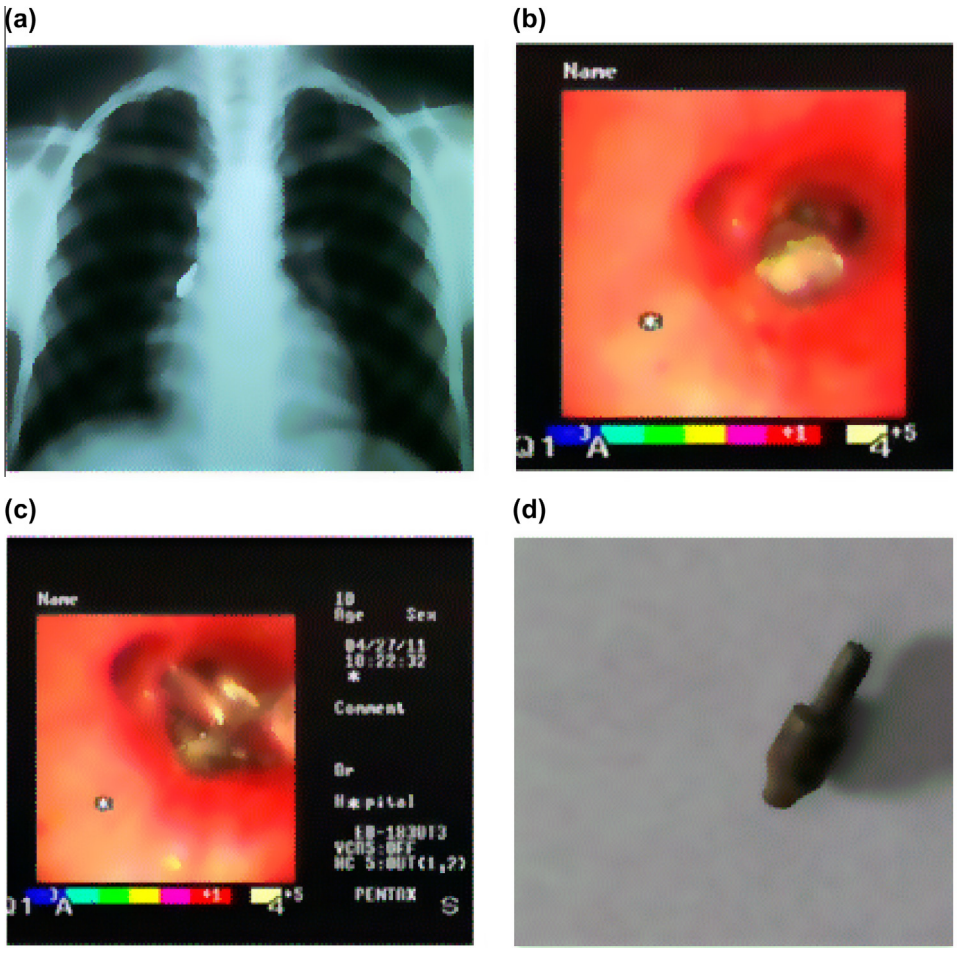

Fig. 2 (a) Chest X-ray shows a metal FB. (b) Bronchoscopic image shows the metal FB lodged in the right lower lobe bronchus. (c) Bronchoscopic image shows the forceps gasping the upper head of the metal FB. (d) Picture of the metal FB after removal by flexible bronchoscopy.

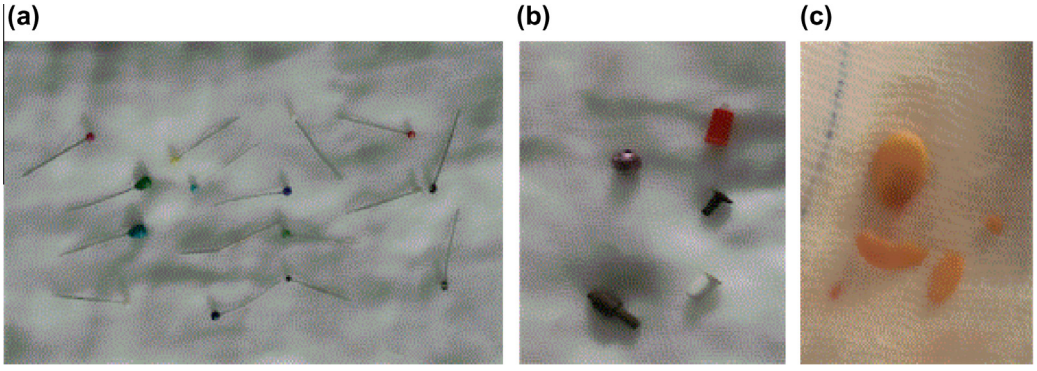

Fig. 3 (a) Picture of several pins removed by flexible bronchoscopy. (b) Picture of different types of FBs removed by flexible bronchoscopy. (c) Picture of seeds removed by flexible bronchoscopy.

adults. The peak incidence of FBA in children is during the age of 1–3 years and boys are predominant [12–15]. Older children are ignorant and frequently aspirate objects that do not belong in their mouth. This is true in our study as the most frequent age of FBA was between 11 and 18 years (47.5%). This age is unusual for FBA but the reason for this may be the type of FB itself.

In most of the studies, FBs aspirated are organic in nature such as seeds, food and bones. Sunflower seed, watermelon seed, and peanut are the most common FBs in children in

China [15]. Whereas, inorganic materials are usually less common, such as pins, coins, plastic whistles, caps of pen and metal remnants [16].

In our study, pins were the most common FB retrieved (77.5%) by flexible bronchoscopy and there was a female predominance as the female to male ratio was 4:1. This could be explained as young females sometimes put pins in their mouth while adjusting their head scarf to fix it later by the pins and frequently it can get aspirated by accident. Also, we remarked that the most common gestures that lead to FBA were laughter and choking (35% and 26.2%) respectively.

Although in most cases FBA is diagnosed in 2–3 days of the event, in a few cases the diagnosis may not be made for several weeks or months. Delay in the diagnosis is considerably shorter in children than in adults, possibly due to parental attention [17]. In our study, the duration of FB retention ranged from 9 h to 12 years with a median of 2 weeks. The delay of diagnosis could be attributed to the belief that the FB was ingested and passed with feces, as well as the non visualization of the FB on the chest radiograph [18].

Chest X ray usually suggests the site of FB, but a non radio-opaque FB is not visualized and sometimes air trapping distal to the obstructed segment could be seen [18]. In our study, normal chest radiology was found in 7 cases (8.8%) and chest X-ray showed radio-opaque foreign body in 78.8% of the patients.

Definite history, paroxysmal coughing, stridor or wheezing, local decreased breath sounds, mediastinum swing, local emphysema or atelectasis may be helpful for the diagnosis of FBA. However, the diagnosis of a pediatric airway FB can be difficult because FBA commonly occurs in infants who are unable to communicate, and the above features are non-specific and may be absent in some patients [19,20].

Table 3 Number, types, gestures that lead to FBA and procedures performed for FB removal.

	Number of patients	Percentage (%)
Number of FBs		
One FB	77	96.2
Multiple FBs	3	3.8
Type of FB inhaled		
Pins	62	77.5
Lodged pointed tip	35	56.5
Free pointed tip	27	43.5
Seeds	6	7.5
Plastic pieces	5	6.3
Metal particles	3	3.8
Chicken bone	2	2.5
Fish fork	1	1.3
Teeth	1	1.3
The gestures of FB inhalation		
Laughter	28	35
Choking	21	26.2
Talking	12	15
Unknown	9	11.2
Sneezing	7	8.8
Hiccough	2	2.5
Trial of endotracheal intubation	1	1.3
Procedures		
Previous unsuccessful FB removal by rigid bronchoscopy	8	10
No attempt for FB removal by rigid bronchoscopy	72	90
Successful removal of FB by flexible bronchoscopy	71	88.8

In our 80 patients, 61 cases were pediatric and 19 cases were adults. Only 71 (88.8%) had a definite history of FBA and 8 patients (10%) had a history of unsuccessful trail of FB removal by rigid bronchoscopy. Furthermore, their symptoms were very common to respiratory infections. The most common symptoms were paroxysmal cough, expectoration and fever (61.3%, 36.3% and 31.1%) respectively. Therefore, complete history and clinical features are crucial in the diagnosis of FBA.

Complications of FBA depend on the site, size, shape, nature and duration of FB retention. FBA can cause a range of sequelae from acute asphyxia and dyspnea to chronic disorders such as recurrent respiratory infections, recurrent pneumonia, lung abscess, atelectasis, post obstructive hyperinflation, hemoptysis and even bronchiectasis [21,22]. Obstruction of the large airways produce dramatic symptoms and the majority of fatalities are caused by round, smooth objects that occlude the airway either supra or infraglottic. On the other hand, smaller objects that pass this site tend to lead to late complications. Retained airway FBs could bring many bronchial changes (thickening of bronchial wall, cartilage damage and fibrosis) when the retention of FBs is longer than 30 days [23].

Reports exist of patients treated as long as 20 years for asthma or COPD when actually a FB was present. Vegetable fragments such as seeds and nuts cause greater acute inflammation than pieces of metal, plastic or bone [24,25]. Although, it is known that the inert nature of the plastic material implies a relatively mild tissue inflammation. However, in our study, the longest FB retention was 12 years in a 30 years old female patient treated for chronic right lower lobe lung abscess, plastic material of paper dossier was retrieved by bronchoscopy. Also another patient had a pin was retained in the right lower lobe treated for 1 year as bronchial asthma. Hence, early diagnosis and management of FBA are mandatory for the prevention of serious complications.

Bronchoscopy is the gold standard in the identification and localization of airway FBs. Although, it is known that in adults, the right bronchus is wilder, shorter and straighter than the left one, FBs are more likely to be lodged on the right while; in children a central location is more predominant [26]. However, in our study the most common location of FB was either the right or left lower lobe bronchus (20%) each, followed by the intermediate bronchus (17.5%), the trachea (15%), left main bronchus (13.8%) and the right main bronchus in (3.8%) of our cases.

Now, bronchoscopy is an important method for the removal of FB. Although rigid bronchoscope has been the first choice for FBA, several data have shown the promising value of flexible bronchoscopy in the extraction of airway FBs [1,2,4,27]. Compared with rigid bronchoscopy, flexible bronchoscopy has many advantages. Firstly, the small diameter and flexibility make it possible to access peripheral bronchi which are difficult to reach by a rigid bronchoscope, such as the grade III or deeper bronchus, the left or right upper bronchus, and the basal segments of the lower bronchus. In our study, 8 patients had a history of unsuccessful rigid bronchoscopy, in 6 of them FBs were successfully retrieved by flexible bronchoscopy. Secondly, flexible bronchoscopy can retrieve

FB in powder or fluid, and endogenous FB (medical powder, mucus or blood plug) by vacuum aspiration or BAL, more easily than rigid bronchoscopy [7]. Thirdly, flexible bronchoscopy is also helpful for clearing local inflammatory secretion, administering drug locally, and investigating the pathogens, which might be beneficial to the control of inflammation and shortening of the hospital stay duration [28,29]. Fourthly, flexible bronchoscopy is suitable for ICU patients or those with severe complications [3,30].

Dikensoy et al. [2] reviewed the results of 457 adults with respiratory tract FB treated by flexible bronchoscopy during the 1970s to the 1990s, with a successful rate of 61–97% (average rate: 83.6%). Ramirez-Figueroa and Swanson used flexible bronchoscopy on 23 and 24 children with FBA, with a high success rate of 91.3% and 100%, respectively [1,4]. Also, Martinot et al. compared the value of flexible and rigid bronchoscopy in the management of 83 children with suspected FBA and concluded that flexible bronchoscopy could be the first choice [31]. Recently, Fang Tang et al. collected the results of management of 1027 patients with FBA, in 938 patients the FBs were removed successfully by flexible bronchoscopy, 37 (3.6%) received bronchoscopy more than once [32].

In the interventional bronchoscopy unit, Kasr el Aini hospital, Cairo University, we used flexible bronchoscopy for FB removal with a high achievement of 88.8%. Only, in 9 cases the FBs cannot be removed by the flexible bronchoscopy. They were 6 female and 3 male patients. In the case of female patients, the foreign bodies were pins in 5 cases. The pins failed to be removed by flexible bronchoscopy in these cases because some were deeply impacted in the airways & others were presenting very distal beyond the vision of the flexible bronchoscope. In case of the female patient with orange seed inhalation, it could not be removed by flexible bronchoscopy due to its slippery surface.

In the 3 male patients with failed attempt of FB removal by flexible bronchoscopy, the FBs were teeth, metal particle and water melon seed. They could not be removed as in the case of the big water melon seed and the metal particle, both obstructed the airways completely and left no space for the forceps to stretch and they were too large to pass through the glottis. In the case of the teeth, one tooth had a too smooth surface to be clipped by the biopsy forceps. Hence, rigid bronchoscopy might be necessary for retrieving some kinds of FBs confirmed by flexible bronchoscopy.

In conclusion, flexible bronchoscopy is successful in retrieving airway foreign bodies (88.8%). With skilled personnel and perfect equipment, flexible bronchoscopy could be considered as the first choice for the removal of airway foreign bodies.

Ethical approval

The Human Study Committee of Kasr el Aini Hospital of Cairo University approved this study.

Contributors

Safy Kaddah wrote the first draft of the paper. Sabah Ahmed is the guarantor. All authors took part in organizing these patients and performing the flexible bronchoscopy.

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None.

Competing interest

None declared.

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